I CLAIM AS MY INVENTION:

1. A method for acquiring a diffusion-weighted image in diffusion-weighted MRT imaging, comprising the steps of:

(a) in a diffusion-weighted measurement, acquiring and storing a non-diffusion-weighted data set from a subject a diffusion-weighted data set by using a DESS sequence by switching two readout gradients successively for acquiring the non-diffusion-weighted data set, and by switching a bipolar diffusion gradient pulse sequence between two readout gradients for acquiring the diffusion-weighted data set; and

(b) calculating a diffusion-weighted MRT image based on the non-diffusion-weighted data set and the diffusion-weighted data set, and based on a value characterizing the diffusion-weighted measurement.

2. A method as claimed in claim 1 comprising employing, as the bipolar diffusion gradient pulse sequence, a positive diffusion gradient pulse with an amplitude G_0 and a negative diffusion gradient pulse with an amplitude $-G_0$, said positive and negative diffusion gradient pulses having the same pulse width δ and one following directly after the other.

3. A method as claimed in claim 2 wherein step (b) comprises employing a b-value as said value characterizing the diffusion-weighted measurement, and calculating the diffusion-weighted MRT image by forming quotients of a combination of the diffusion-weighted data set and the non-diffusion-weighted data set, logarithmizing the quotients, and weighting the logarithmized quotients with the b-value.

4. A method as claimed in claim 3 wherein said diffusion-weighted MRT image is comprised of pixels, and wherein step (a) comprises conducting said diffusion-weighted measurement for a selected nuclear spin type, and wherein step (b) comprises forming the diffusion -weighted MRT image by representing each pixel by an ADC coefficient D_{ADC} determined per pixel from the acquired data sets according to

$$D_{ADC} = \frac{1}{2 * b_{bip}} \ln \frac{S_0^- * S_{Diff}^+}{S_{Diff}^- * S_0^+},$$

wherein S_0^+ and S_0^- represent the data set of the non-diffusion-weighted measurement as FISP echo signals and as PSIF echo signals, respectively, and S_{Diff}^+ and S_{Diff}^- represent the data set of the diffusion-weighted measurement as FISP echo signals and as PSIF echo signals, respectively, and wherein b_{bip} represents the value characterizing the diffusion-weighted measurement according to

$$b_{bip} = \frac{1}{6} \gamma^2 G_0{}^2 \delta^3$$

wherein γ is the gyromagnetic ratio of the nuclear spin type.

5. A method as claimed in claim 4 comprising acquiring the FISP echo signals for S_0^+ and S_{Diff}^+ with a bandwidth that is higher than a bandwidth employed for acquiring the PSIF echo signals for S_0^+ and S_{Diff}^+.

6. A method as claimed in claim 4 comprising acquiring the FISP echo signals for S_0^+ and S_{Diff}^+ with a bandwidth that is the same bandwidth employed for acquiring the PSIF echo signals for S_{0+} and S_{Diff}^+ and acquiring the FISP echo signals for S_0^+ repeatedly using a multi-gradient echo sequence with averaging over

all acquired signals for S_0^+, and acquiring the FISP signals for S_{Diff}^+ using a multi-gradient echo sequence with averaging over all acquired signals for S_{Diff}^+.

7. A method as claimed in claim 6 comprising employing a quadratic sum method for said averaging of S_0^+ and S_{Diff}^+.

8. A method as claimed in claim 4 comprising acquiring the data sets S_{Diff}^-, S_{Diff}^+, S_0^-, S_0^+ using a projection-reconstruction method.

9. A magnetic resonance imaging apparatus for acquiring a diffusion-weighted image in diffusion-weighted MRT imaging, comprising:

a magnetic resonance scanner adapted to receive a subject, said scanner, in a diffusion-weighted measurement, acquiring and storing a non-diffusion-weighted data set and a diffusion-weighted data set from the subject using a DESS sequence by switching two readout gradients successively for acquiring the non-diffusion-weighted data set, and by switching a bipolar diffusion gradient pulse sequence between two readout gradients for acquiring the diffusion-weighted data set; and

a processor for calculating a diffusion-weighted MRT image based on the non-diffusion-weighted data set and the diffusion-weighted data set, and based on a value characterizing the diffusion-weighted measurement.

10. An apparatus as claimed in claim 9 wherein said scanner generates, as the bipolar diffusion gradient pulse sequence, a positive diffusion gradient pulse with an amplitude G_0 and a negative diffusion gradient pulse with an amplitude $-G_0$, said positive and negative diffusion pulses having the same pulse width δ and one following directly after the other.

11. An apparatus as claimed in claim 10 wherein said processor employs a b-value as said value characterizing the diffusion-weighted measurement, and calculates the diffusion-weighted MRT image by forming quotients of a combination of the diffusion-weighted data set and the non-diffusion-weighted data set, logarithmizing the quotients, and weighting the logarithmized quotients with the b-value.

12. An apparatus as claimed in claim 11 wherein said diffusion-weighted MRT image is comprised of pixels, and wherein the scanner conducts said diffusion-weighted measurement for a selected nuclear spin type, and wherein the processor forms the diffusion -weighted MRT image by representing each pixel by an ADC coefficient D_{ADC} determined per pixel from the acquired data sets according to

$$D_{ADC} = \frac{1}{2 * b_{bip}} \ln \frac{S_0^- * S_{Diff}^+}{S_{Diff}^- * S_0^+},$$

wherein S_0^+ and S_0^- represent the data set of the non-diffusion-weighted measurement as FISP echo signals and as PSIF echo signals, respectively, and S_{Diff}^+ and S_{Diff}^- represent the data set of the diffusion-weighted measurement as FISP echo signals and as PSIF echo signals, respectively, and wherein b_{bip} represents the value characterizing the diffusion-weighted measurement according to

$$b_{bip} = \frac{1}{6} \gamma^2 G_0{}^2 \delta^3$$

wherein γ is the gyromagnetic ratio of the nuclear spin type.

13. An apparatus as claimed in claim 12 wherein the scanner acquires the FISP echo signal for S_0^+ and S_{Diff}^+ with a bandwidth that is higher than a bandwidth employed for acquiring the PSIF echo signals for S_0^+ and S_{Diff}^+.

14. An apparatus as claimed in claim 12 wherein the scanner acquires the FISP echo signals for S_0^+ and S_{Diff}^+ with a bandwidth that is the same bandwidth employed for acquiring the PSIF echo signals for S_0^+ and S_{Diff}^+, and acquiring the FISP echo signals for repeatedly using a multi-gradient echo sequence with the processor averaging over all acquired signals for S_0^+, and acquires the FISP signals for S_{Diff}^+ repeatedly using a multi-gradient echo sequence with the processor averaging over all acquired signals for S_{Diff}^+.

15. An apparatus as claimed in claim 14 wherein the processor employs a quadratic sum method for said averaging of S_0^+ and S_{Diff}^+.

16. An apparatus as claimed in claim 12 wherein the processor acquires the data sets S_{Diff}^-, S_{Diff}^+, S_0^-, S_0^+ using a projection-reconstruction method.